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BACTERIOLOGIC STUDIES OF THE UPPER RESPIRATORY PASSAGES

I. HEMOLYTIC STREPTOCOCCI OF THE ADENOIDS

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Numerous bacteriologic investigations of the throat and nasopharynx have been carried out to determine the incidence of dangerous bacteria in the normal as well as in diseased conditions. Most of the previous observations were made from swab cultures of the throat and pharynx, and as it is impossible for this method to reach the recesses of the tonsillar crypts and folds of the adenoids, it is obvious that the results obtained are inaccurate and not a true index of the flora of these regions. In a previous work by Pilot and Davis¹ it was noted that the crypts of 100 pairs of extirpated tonsils contained hemolytic streptococci often in large numbers in 97%, whereas from the swab cultures of the same persons before tonsillectomy the same organisms were recovered in fewer numbers in only 61%. In order to ascertain the extent to which the other lymphoid structures harbor the streptococci a study of the flora of the extirpated adenoids of a similar group of persons was undertaken, together with a smaller series of extirpated tonsils for comparison.

In the present work cultures were made from the adenoids of 103 children. In 25 instances swabs of the nasopharynx were obtained by means of the West tube before adenoidectomy and in the same group both the extirpated tonsils and adenoids were studied. In the remaining 78 cultures were made from the adenoids. The patients were children varying from 5 to 16 years of age who presented adenoids and tonsils of varying degrees of hyperplasia with no evidence of any recent acute inflammation, fever or subjective symptoms of sore throat. The adenoids in most instances were removed by the La Force adenectome and the tonsils by the Beck tonsillectome under general anesthesia at the Cook County Hospital during the months of April, May and June, 1920.

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¹ Jour. Infect. Dis., 1919, 24, p. 386.

The adenoids consisted of hyperplastic lymphoid tissue from 1 to 1.5 cm. square and about 1 cm. thick. Structurally many presented from 3 to 6 deep folds; in others fibrous union had taken place between the folds leaving pits not unlike the tonsillar crypts but not quite as deep. Most of the specimens had both folds and crypt-like depressions. Fatty debris and cholesterol crystals were encountered in a few instances, but in none was a purulent exudate seen. The tonsils of the same persons, like the adenoids, were of lymphoid tissue of varying degrees of hyperplasia. Occasionally the crypts contained fatty debris and hard yellow actinomyces-like granules. Such granules were not grossly visible in the adenoids.

THE PERCENTAGE OF HEMOLYTIC STREPTOCOCCI IN CULTURES OF THE NASOPHARYNGEAL SWABS AND ADENOIDS OF THE SAME PERSONS

	Number of Persons	Percentage Positive
Series i.		
Swab cultures	25	40
Cultures from depths of adenoids.....	25	60
Series ii.		
Cultures from the surface of the adenoids.....	78	58
Cultures from the depths of the adenoids.....	78	62
Total number of swab and adenoid surfaces from which cultures were taken.....	103	55
Total number of cultures from the adenoid depths....	103	61

All the material was collected separately in sterile gauze and cultures made in 1 to 4 hours after removal. Material for culture was obtained by streaking the epithelial surface of the vegetations with a wire loop and then carefully separating the folds and mouths of the pits with sterile forceps another culture was obtained from the depths. The tonsils were inverted with the capsule outside and incised transversely at right angles to the crypts with a sterile knife and cultures made from the bottom of the crypts. The wire loops were streaked on the surface of blood-agar plates made up of infusion agar titrated to a hydrogen-ion concentration of 7.6 to which human blood was added in proportion of one part of blood to 10 to 15 parts of agar. In addition the same medium in the melted state of 45 C. was inoculated from the same sources and poured into plates. The plates were incubated at 37.5 C. and examined at the end of 24 and 48 hours for hemolytic colonies.

Small, discrete, biconvex, gray-white colonies forming zones of complete hemolysis measuring from 1 to 4 mm. across were noted and isolated in pure culture on blood-agar slants for further study and confirmation,

In the cultures of the nasopharyngeal swabs hemolytic streptococci were present in 10 of 25 instances, or in 40% of the cases. From the same persons the streptococci were present in the depths of the adenoid vegetations in 15, or 60%, demonstrating the inaccuracy of the swab culture. In the remaining 78 cultures made from the surface of the adenoids they occurred in 45, or 58%, as compared with 48, or 62%, positive in the adenoids depths. In both the swab and surface cultures they were relatively few in number, seldom predominant and numerous in only 9 instances. In the depths, however, they were present in decidedly larger numbers, being quite numerous in 18 instances and in pure culture in 3. The foregoing figures were obtained by examination of the poured plates. It is interesting to note that from the streaked blood-agar plates the hemolytic streptococci were observed in only 26% of the cultures of the adenoid surface and in 37% of those of the depths, demonstrating definitely the superiority of the poured plate in the detection of these organisms.

Of the 21 pairs 20, or 95%, revealed hemolytic streptococci in either both or one tonsil. In the adenoids of the same persons these organisms occurred in 15, giving 5 instances in which streptococci were recovered from the tonsils and not from the adenoids. Furthermore, the tonsillar crypts harbor these organisms in greater numbers as compared with the adenoids. The crypt-like structures of the nasopharyngeal vegetations, like the crypts of the tonsils, frequently contain these streptococci in strikingly large numbers, showing the strong tendency of the hemolytic streptococcus to flourish in the deep depressions of the lymphoid tissue of the oro- and naso-pharynx.

The streptococci corresponded to the beta type of Smith and Brown. The narrow, indefinitely hemolytic colonies of the alpha type were present in 20% and were included in the nonhemolytic streptococcus group.

Sixty-five strains of hemolytic streptococci, of which 60 were isolated from the adenoids, were studied in pure culture. All were bile insoluble and hemolytic in the subcultures. In infusion carbohydrate broth they formed a flocculent sediment, while the supernatant fluid usually remained clear. Smears revealed gram-positive cocci in moderately long or often very long chains. Four differential sugars were inoculated—lactose, salicin, mannite and inulin. The medium consisted of infusion broth with 1% carbohydrate and Andrade indicator. Readings were made at the end of 4 and 10 days. All fermented lactose,

all but 3 salicin; 3 fermented mannite, and 2 inulin. Inulin from another source was not fermented by the 2 strains. According to Holman's classification, 59 were streptococcus pyogenes, 2 strep. infrequens, 2 strep. anginosus, and 1 strep. hemolyticus 3. Litmus milk was acidified by all in 7 days, 10 coagulating spontaneously and the remainder on gentle heating.

Eight strains were selected at random and injected intravenously into rabbits. These strains were isolated from the adenoids or the nasopharynx. In 2 instances 2 c c of a serum-broth culture incubated 48 hours were employed and one rabbit died in 24 hours with evidences of a septicemia and beginning arthritis. The second rabbit died in 72 hours and at necropsy had a moderately purulent polyarthritis and vegetations on the aortic valves. Five other rabbits, weighing from 800 to 2,000 gm., were inoculated with a blood-agar slant (incubated 48 hours) suspended in salt solution. One died in 48 hours and revealed petechial hemorrhages on the serous surfaces and many streptococci in the heart blood. Another succumbed on the 13th day from a marked purulent polyarthritis and peri-arthritis, and periostitis of two adjacent ribs. The remaining 3, killed on the 11th day, showed polyarthritis of varying severity. One rabbit which received one-half of blood-agar slant also developed purulent arthritis. The joints involved were chiefly those of the wrists, ankles, knees and phalanges. Five other strains were introduced into white mice in doses of 0.5 c c of a 24-hour serum-broth culture intraperitoneally. Four died within 18 hours and the fifth in 36 hours, and from all the streptococci were recovered from the peritoneal exudate and the heart blood.

SUMMARY

Hemolytic streptococci are common in the nasopharynx and nasopharyngeal vegetations. From nasopharyngeal swabs and the surface of the adenoids hemolytic streptococci were recovered in 55%; from the depths between the folds and of the crypt-like depressions of the adenoids of the same persons, in 61% in larger numbers. The excised tonsils of the same patients revealed hemolytic streptococci in still larger numbers in 95%.

These streptococci agree in their morphology, cultural characteristics, fermentation reactions and pathogenicity, and are practically identical with hemolytic streptococci from various human sources.

The adenoids, like the tonsils, are to be considered as common foci harboring hemolytic streptococci.